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A meta-analysis of development aid allocation: The effects of income level and population size

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Abstract:

The effect on aid allocation of the income level and population size in the recipient country is analyzed. The data show that both variables have a significant and robust negative effect, but they explain only a small part of the variation. The main thrust of the paper is a meta-analysis of the large aid allocation literature, where the impact of the two variables is analyzed, controlled for a wide range of factors. By the standard meta-tests, the results converge to much the same as found in our own analysis of the data. The poverty effect is in accordance with stated policies of all donors, while the population effect appears contrary to the stated policy of all donors. The main multilateral donors do not influence this pattern. Indeed, the evidence suggests that the poverty effect is smaller for the multilateral donors. Six main hypotheses are presented to explain the population effect.

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1. Introduction

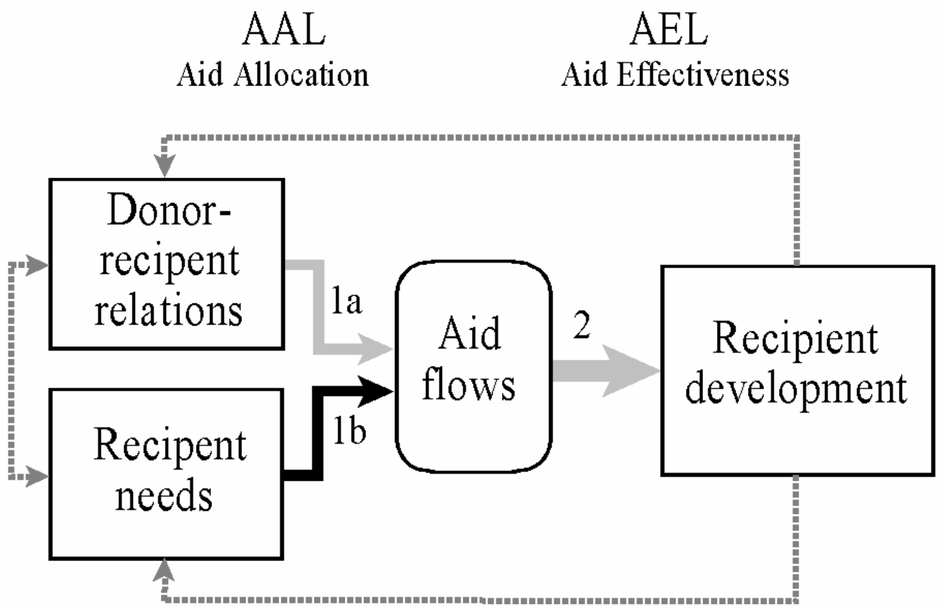
A substantial literature of more than 270 papers and books studies development aid empirically. The literature concentrates on the three main causal flows shown on Figure 1. It is divided into the Aid Allocation Literature (AAL) dealing with the causal relations (1a) and (1b), and the Aid Effectiveness Literature (AEL) dealing with the causal relation (2).

The present paper looks at (1b). Two of the main factors determining the needs of a country are low income (level) and population size. The AAL suggests that we should look for three effects of these variables:

(e1) A ***poverty effect***: Income has a negative effect on aid allocation.
(e2) A ***middle-income effect*****:** The aid-income curve is convex.[1]
(e3) A ***population effect***:[2] Population size has a negative effect on aid allocation.

This paper confirms (e1) and (e2), while (e2) is found to be dubious. It is also shown that both significant effects explain only a small part of the variation in the data. In this paper, we are looking at both bilateral and multilateral donors, and compare their behavior.

Figure 1. The causal relations analyzed in the empirical aid literatures



Note: The present paper concentrates on parts of relation (1b).

1. That is, the aid-income relation does not fall linearly with income, but has a section above the best linear fit.
2. This effect is often referred to as the *country-size effect*.

The analysis is undertaken in two ways: (i) By a primary analysis of the data, and (ii) by a meta-analysis of the extant empirical literature. Both (i) and (ii) reach the same conclusions. Especially (ii) provides strong evidence showing that both the poverty effect and the population effect are robust to everything researchers have done to make sure that they hold. Even when they are parts of larger models controlling for other factors, they still remain robust.

The allocation of aid is an aspect of the policy of countries and multilateral organizations for which good statistics exist, so the study of these flows gives an important insight into the behavior of the said agents. In particular, it tells a great deal about the World Bank, which is the main multilateral aid agent.

Donor agencies state their goals, which are normally humanitarian. The main theme of the AAL is to compare the stated goals with the pattern actually found. To the extent that the actual pattern deviates, one may say that the allocation process contains biases. All donors stress that poverty reduction is the main goal of development aid.[3] Thus, the poverty effect appears to be fully consistent with the stated goals. However, the low explanatory power of the effect is problematic. Also, to the limited extent that a middle-income effect exists, it is a bias in the allocation process.

It appears that no donor agency states that poverty in large countries is less important than poverty in small ones so that aid should go disproportionably to smaller countries. It is certainly against the goals stated by the main multilateral agencies. Consequently, the population effect is a bias in the aid allocation process.

Many other biases have been found in the literature. Some of these biases are easy to understand as they represent *historical ties,* as well as *strategic* and *commercial interests*, which is the flow (1a) on Figure 1. The population effect is a general effect which has no direct link to these factors. The meta study shows that even when these factors are controlled for, the population effect remains.

Thus, the case of the poverty effect vs the population effect is important as it is a rather clear divergence between the humanitarian goal and a bias due to the way political-administrative systems work.

Christensen, Doucouliagos and Paldam (2007a, b) are bibliographies of the AEL till 1/1-2005, and the AAL till 1/1-2006. We have searched diligently to make the bibliographies complete. The papers collected have provided the data to a set of meta-analysis studies. The

3. It should be mentioned though that there has been rather large fluctuations in the beliefs in the donor countries about the best ways to reach the goal of poverty reaction.

AEL has already been covered, and we are gradually covering the AAL as well, see Doucouliagos and Paldam (2006-07). The present paper is an independently readable part of that project.

Section 2 offers our own exploration of the data to see if they support the three effects. Section 3 is a meta study of the 1,030 estimates of effect of income, while Section 4 is a parallel meta study of the 747 estimates of the effect of population. Section 5 discusses the explanations of the effects, notably the population effect. Section 6 concludes the paper. The studies covered by the meta-analysis are listed in Appendix A.

2. The basic facts analyzed

The purpose of this section is to take a basic look at the data before we turn to the meta studies of the literature. The paper uses *all* observations available in the sources mentioned for the following four variables. The reader should note the crucial difference between *h* and *d* (that is used in the meta-studies):

(*h*) The *aid share, h.* It is ODA as a percentage of GNI from WDI.[4]

(*d*) The *share of aid*, *d*. It is in percentage of the aid to a country.

(*y*) Initial *income*, *y*. It is the natural logarithm to gdp, the GDP per capita. We here use the PPP data from Maddison (2003).

(*n*) Initial *population, n*. It is the natural logarithm to the population from the WDI.[5]

Table 1. The nine 5-year periods covered by the data

	h	*y & n*		*h*	*y & n*		*h*	*y & n*
P1	1961-65	1960	P4	1976-80	1975	P7	1991-95	1990
P2	1966-70	1965	P5	1981-85	1980	P8	1996-00	1995
P3	1971-75	1970	P6	1986-90	1995	P9	2001-05	2000

Note: The variables are defined in the text. Table 3 gives the number of observations per period.

2.1 Looking for the three effects in the data

For the 9 periods listed in Table 1, the three variables, *h*, *y* and *n*, are displayed on Figures 1 and 2 where the aid share is "explained" by initial income and initial population. Nine observations with aid shares above 50% have been deleted on the graphs. They do not change the form of the curves, but if they are shown, the big mass of data is compressed so much that it makes the graphs difficult to read.

The first observation from the two graphs is that they show a dramatic scatter. Aid shares are all over the place. The two organizing variables – income and population – only organize a minor part of the variation. However, they do explain something, and both the *poverty effect* and the *population effect* are clearly visible on the graphs.

4. WDI is the World Development Indicators (net). For most countries, data for GDP and GNI are the same. The aid statistics originate from the DAC of the OECD, so all donors are the rich western democracies.

5. In the studies covered by the meta-analysis, it is sometimes not initial population but average or even final population that is used, but due to the strong autocorrelation in these series, this is of little importance.

Figure 2. The aid share and initial income, $N = 960$, including Kernel regression

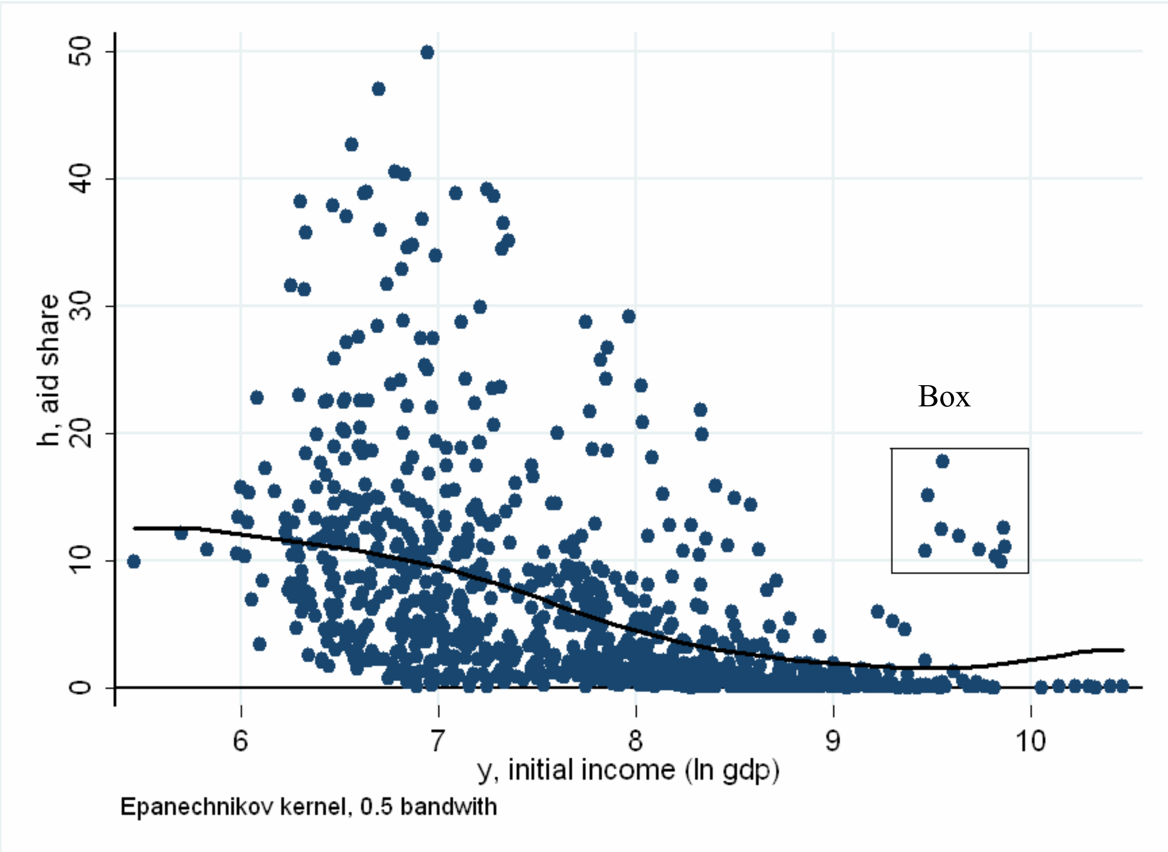
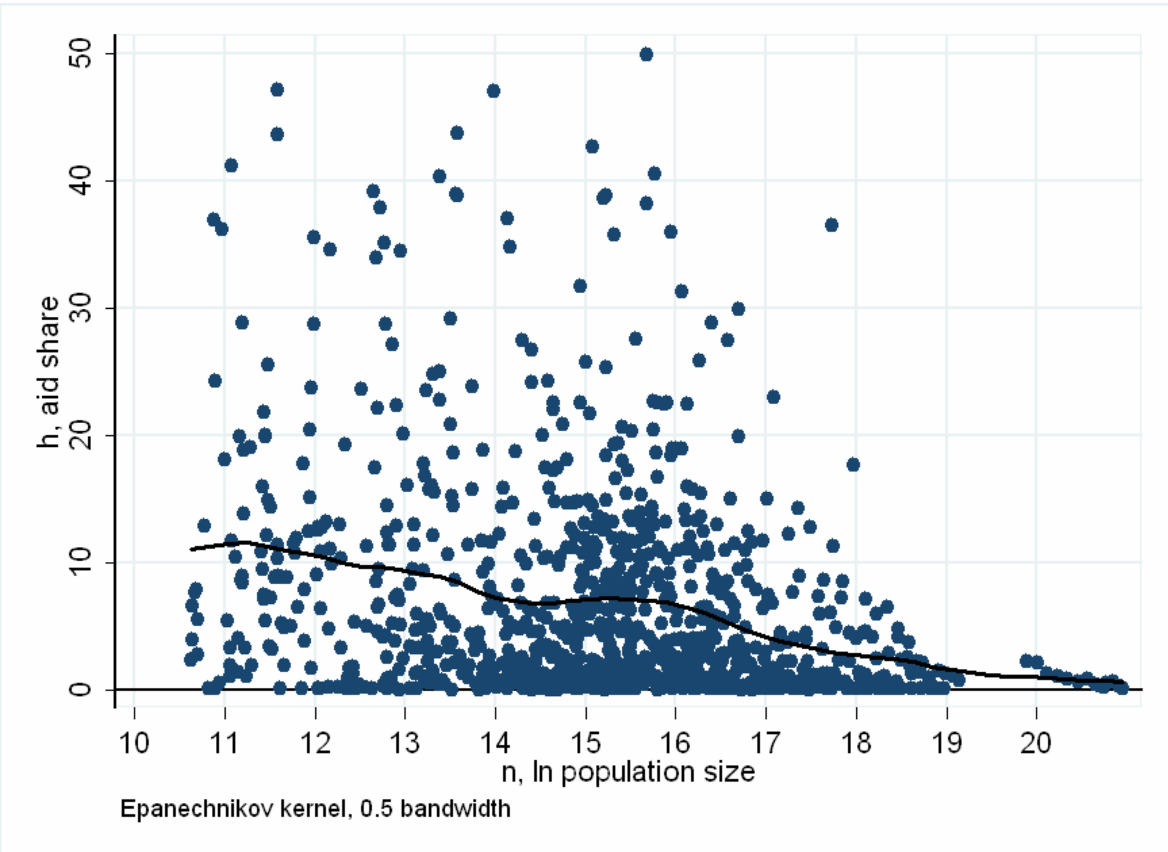


Figure 3. The aid share and initial population, $N = 1,016$, including Kernel regression



To test the hypothesis of the middle-income effect (from Isenman 1975), a set of kernel regressions – with bandwidths of 0.1, 0.2, …, 4 – has been run. The lowest bandwidths give a zig-zag pattern and the highest give a flat curve. However, from about 0.3 to almost 1.0, the curves shown in Figures 2 and 3 emerge. The kernel regressions are approximations of the aid-income curve and the aid-population curve.

The ***aid-income curve*** has a clear downward slope, and in addition it has two features: (1) It is fairly flat until about 7 – which is an income level similar to the one of South Korea in 1960 and Cameroon in 2000. Thus, it matters for aid that countries are poor, but not so much if they are very poor or just poor. (2) The curve turns up at the end. This is due to the 10 observations in the box. They are all from two small French dependencies: New Caledonia and French Polynesia.[6] Without these two cases, the aid-income curve would keep falling. That is, the data does not give a clear support for the hypothesis of a middle level peak. This is also confirmed by the meta-analysis presented below.

As regards the ***aid-population curve***, no signs of deviations from a straight line appeared: The aid share falls linearly to population.

2.2 The format of Tables 2 and 3

Figures 2 and 3 tell us that we may run linear regressions explaining the aid share, *h*, by population, *n*, and income, *y,* as is done in Tables 2 and 3. In addition, the regressions use fixed effects for the nine periods (defined in Table 1), and dummies for China and India – to check if the effect of size hinges upon the two giants. It is reassuring that the two giant-dummies are insignificant in all regressions containing *n.*

The table reports AR^2, which is the R^2 adjusted for degrees of freedom. It includes the effects of the period dummies. The MAR^2 is calculated by subtracting the AR^2 for a regression that contains the fixed effects only. It is thus the AR^2 of the interesting variables.
The 766 observations used are data-sets where the 3 observations (*h, y, n*) are available, which do not belong in one of the following three groups: (i) high income countries, (ii) middle income oil countries, and (iii) countries in transition from socialism. Note that the 766 sets used are 72% of the potential 118 *x* 9 = 1,062 sets. However, the aid programs started in the 1960s, so the data for the first periods cover 61 and 67 countries only.

6. New Caledonia has a population of 220,000, of which 35% are French. French Polynesia has a population of 270,000, of which 10% are French. They both receive an annual subsidy of about 15% that is classified as aid. Note that Israel ceased to receive much economic aid as it became wealthier.

Table 2. Explaining the aid share by population size and income,
and two regressions explaining income by population size

Explained	(1) Aid share	(1b) [a)] Aid share	(2) Aid share	(3) Aid share	(4) Aid share	(5) Aid share	(6) Income	(7) Income
Ln pop, *n* initial	**-2.12**	**-1.62**	**-2.07**	**-1.72**			**-0.066**	**-0.067**
(t-ratio)	(-11.7)	(-12.9)	(-12.3)	(-8.5)			(-4.3)	(-4.1)
Ln gdp, *y* initial	**-5.89**	**-5.04**	**-5.88**		**-5.19**	**-5.11**		
(t-ratio)	(-14.6)	(-18.3)	(-14.6)		(-12.0)	(-11.7)		
China dummy	2.49	0.86		0.18	**-9.32**			0.39
(t-ratio)	(0.6)	(0.3)		(0.0)	(-2.2)			(1.1)
India dummy	1.18	-0.24		2.07	**-9.18**			-0.15
(t-ratio)	(0.4)	(-0.1)		(0.6)	(-2.8)			(-0.5)
All regressions contain fixed effects (FE) for the nine periods								
AR^2 , incl. FE	0.57	0.68	0.57	0.44	0.49	0.48	0.988	0.988
MAR^2, excl. FE	0.18	0.20	0.18	0.06	0.10	0.09	0.0003	0.0003
N	766	753	766	766	766	766	766	766

Note: All 188 LDCs covered by the WDI Estimates with t-ratios above 2 are bolded. If the dummies for the two giant countries are omitted in (3) and (4), the estimate of the coefficient on *n* in (3) changes to **-1.69** (-8.9).
a. 13 observations where h > 40 are excluded. FE denotes Fixed Effects.

Table 3. Results for the individual periods: Explaining the aid share

	(1) Ln population	(2) Ln gdp	(3) Constant	(4) AR^2	(5) N
P1, 60-65	**-1.16** (-3.5)	**-2.47** (-3.4)	**39.00** (5.3)	0.26	61
P2, 65-70	**-1.48** (-6.0)	**-2.85** (-5.2)	**47.56** (8.4)	0.47	67
P3, 70-75	**-1.60** (-5.0)	**-3.19** (-4.5)	**53.23** (7.2)	0.37	70
P4, 75-80	**-2.54** (-5.6)	**-4.33** (-4.3)	**78.82** (7.0)	0.34	79
P5, 80-85	**-1.93** (-5.0)	**-4.95** (-5.1)	**74.89** (7.5)	0.33	88
P6, 85-90	**-2.68** (-5.8)	**-6.79** (-5.7)	**102.42** (8.4)	0.36	97
P7, 90-95	**-2.98** (-4.2)	**-9.46** (-5.3)	**129.53** (6.7)	0.26	101
P8, 95-00	**-2.00** (-4.6)	**-5.98** (-5.8)	**84.46** (7.5)	0.30	103
P9, 00-05	**-1.44** (-3.2)	**-7.38** (-7.2)	**87.44** (7.8)	0.36	100
Average	**-1.98** [-3.3]	**-5.27** [-2.4]	**77.48** [2.9]		
All	**-2.02** (-11.3)	**-5.20** (-12.4)	**78.02** (17.3)	0.24	766
All FE[a)]	**-2.07** (-12.3)	**-5.88** (-14.6)	Fixed effects	0.18	766
Trend	-0.09 (-1.2)	**-0.73** (-4.4)	**8.01** (3.2)		

Note. Same data as for Table 2. Brackets contain t-ratios. The square brackets give t-ratios for cross period stability. a. Regression (2) from Table 2. The AR^2 included is the MAR^2 for comparability. The trend test is done by defining a trend variable 1, ..,9 for the periods P1,…, P9, and running an OLS-regression on the coefficients in the column above, using the trend as the regressor. It is significant for income but not for population.

The regressions in the two tables are run as stacked OLS regressions on all available observations. This assumes that there is no simultaneity in the relations. The dummies are exogenous and so is population. We know from the convergence literature that the correlation between y and the real growth rate, g, is about zero in the shorter run. Our meta study of the aid to growth literature (Doucouliagos and Paldam 2007a) demonstrates that causality from h to g is at most very weak. Also, we use the initial values of y. Hence, we take all causality between h and y to run from y to h.

2.3 The regression results

Table 2 presents the results of the basic regressions. The initial population, n, and initial income, y, both produce very significant and stable negative coefficients in all regressions of both tables. The two coefficients have only a small degree of multicollinearity as can be seen by comparing estimate (1) with (3) and (4). There is actually a small effect from population to the income level as can be seen in estimates (5) and (6). Interestingly, it appears that larger countries are marginally poorer. However, this effect is so small that it is almost irrelevant, see also the last line of Table 4 below.[7]

Table 4. Estimated effect of country differences

From estimated equation			1.5 times	2 times	5 times	10 times
Effect on	Of	Coeff.	Ln(1.5) = 0.41	Ln(2) = 0.69	Ln(5) = 1.61	Ln(10) = 2.30
Aid share	Income	-5.9	-2.4	-4.1	-9.5	-13.6
Aid share	Population size	-2.1	-0.9	-1.4	-3.4	-4.8
Income level	Population size	-0.07	-0.03	-0.05	-0.11	-0.16

It is interesting to note (from the trend-line at the bottom of Table 3) that both effects increase over time, though only the poverty effect does so significantly: Aid does become more poverty oriented, and the population effect does not fall, but rather rises.

The variables are measured in logarithmic form. Thus, it is worth calculating what they mean. This is done in Table 4. The average aid share is 8% for the 766 observations. The distribution is quite skewed. The countries in Sub-Saharan Africa have since 1980 received aid of about 15% of GDP on average. With these orders of magnitude in mind, Table 4 shows

7. We should mention that regressions (1) to (5) have been re-run after deleting all 13 sets where the aid share is larger than 40%, and all 31 sets where the aid share is larger than 30%. The 12 regressions show that the basic results fall a little when extreme values are excluded, but both the significance and the explanatory power (the MAR^2 score) raise a little in most cases. Only one of these regressions is included – it is (1b).

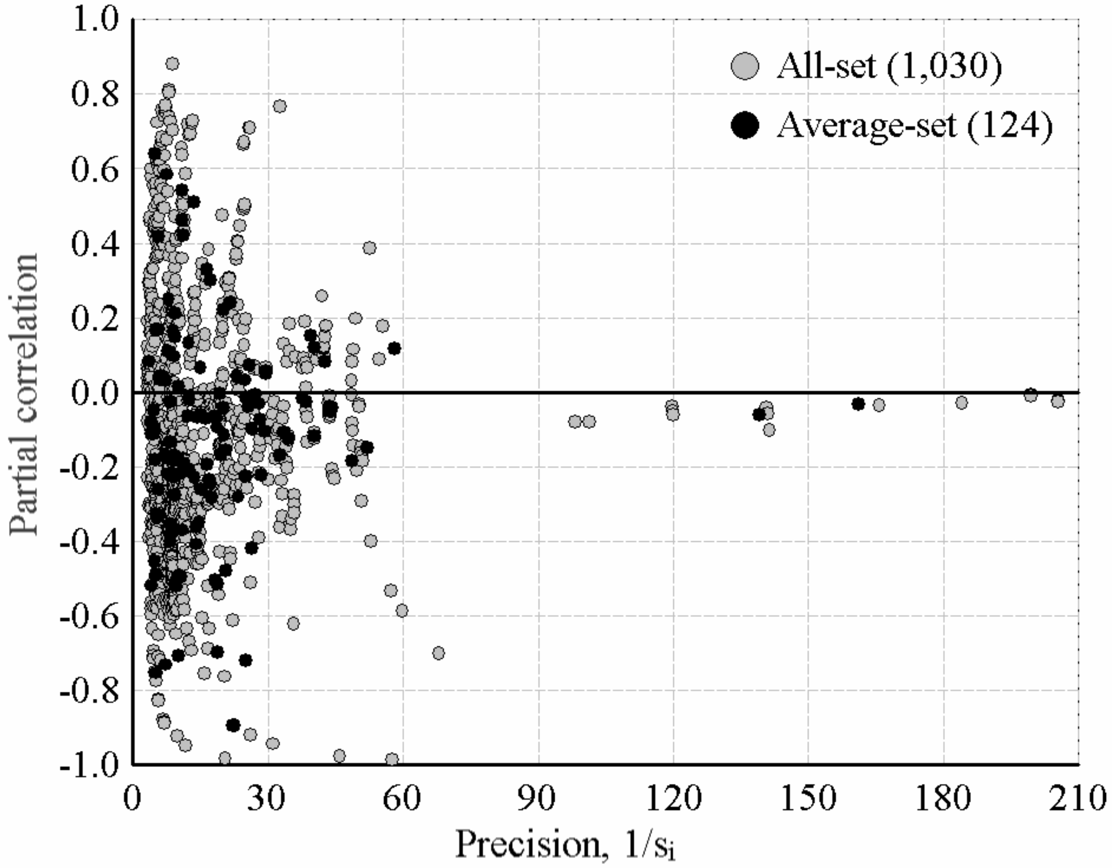
that the group of countries which are 5 times richer than the average Sub-Saharan African country receive about 9.5 percentage points less in aid. That is about 5% instead of 15%. This appears rather reasonable. However, it is much less reasonable to see that if two countries at the same standard of living differ in populations by a factor of 10 times, people in the larger country receive 4.8 percentage points less aid.

The MAR^2 of the two variables is only about 0.18, of which we can ascribe 0.09 to the effect of income and 0.06 to the effect of size. Consequently, the two variables do not explain very much. In particular, we note that the poverty of countries (measured as we do) barely explains 10% of the variation in the aid shares.

3. Meta study 1: The poverty effect and the middle-income effect

124 of the 166 studies listed in Christensen, Doucouliagos and Paldam (2007b) contain 1,030 comparable estimates of the effect of income on the aid share. Two datasets are used: (1) the ***all-set*** of 1,030 comparable estimates, which is the population of reported estimates, and (2) the ***average-set*** of 124 estimates, one from each study constructed by taking the average finding in the study. This section is a meta study of these estimates.[8]

Figure 4. Funnel plot of estimates of the income effect



3.1 The funnel plot of the estimates of the poverty effect

Figure 4 is a funnel plot of the estimates, converted to partial correlations to be comparable. Funnel plots are used as a graphical way of illustrating the distribution of empirical findings, showing the relationship between an effect (partial correlations in our case) and a measure of

8. Research is a process of truth searching where new results are produced by *innovation*, and confidence is built by *independent replication* (that is replications by other researchers on new datasets). Meta-analysis is a quantitative study of this process. It can be applied to a body of literature estimating the same effect to study if the effect is robust in the data.

precision (1/se). See Stanley (2005) for details and other examples. As usual, it is amazing to see how much the results vary. The reported results range from -1 to almost +1.

The plot suggests a pattern: (1) the funnel converges to something negative, and (2) the funnel appears to be fairly symmetrical around that average, but there are more negative estimates reported. These properties are tested formally in Table 6, and found to be true.

3.2 The FAT-PET MRA technique[9]

The FAT-PET MRA model (Stanley 2007) is used to identify the direction and magnitude of the income effect. The MRA involves estimating a variant of the following model:

$$\varepsilon_i = \beta_0 + \beta_2 Z_i + \nu_i \tag{1}$$

where ε_i denotes the standardized effect size for estimate *i*, and $\boldsymbol{Z}$ is a vector of study characteristics such as data, specification, and estimation differences. β_0 is the estimate of the population parameter of interest.

Equation 1 is known as a fixed effects MRA model, and it can be estimated using OLS.[10] Like any regression analysis, drawing valid inferences from the estimated coefficients of equation 1 requires that the observed data is representative. Unfortunately, there is ample evidence showing that empirical economics is affected by selection bias (see Roberts and Stanley 2005). Also known as publication bias, selection bias means that certain results are difficult to publish and, hence, remain unavailable to the public. If it is severe, this truncation can lead to faulty inference (Stanley 2007).

The FAT-PET MRA model has been developed to analyze a literature that is affected by such selection bias. The logic of FAT-PET is as follows. Smaller samples have larger standard errors. If publication selection bias is absent from a literature, no association between a study's reported effect and its standard error should appear. However, if there is publication selection bias, smaller studies will search for larger effects in order to compensate for their larger standard errors.[11] This suggests running the following regression:

9. ***FAT*** is Funnel Asymmetry Test, ***PET*** is Precision-Effect Test, and ***MRA*** is Meta Regression Analysis.

10. Equation 1 assumes that all differences between studies can be explained by sampling error and identifiable differences between studies. If some of the study differences are random and unidentifiable, then a mixed effects version of equation 1 can be estimated (see Doucouliagos and Paldam 2007a for details).

11. This can be done by modifying specifications, functional form, samples, and even estimation technique.

$\varepsilon_i = \beta_0 + \beta_1 s_i + v_i$ (2)

where s_i is the standard error associated with ε_i. Equation 2 for heteroskedasticity by dividing through by s_i and, hence, running the following FAT regression:

$t_i = \varepsilon_i / s_i = \beta_1 + \beta_0 (1/s_i) + v_i$, which is the FAT-PET MRA equation (3)

The term *FAT* is used as the regression and is related directly to funnel plots, and it is designed to detect statistically funnel asymmetry (hence the name). For details on the test, see Egger *et al.* (1997), Sutton *et al*. (2000), Rothstein *et al.* (2005), and Stanley (2005). If publication selection bias is present, the constant, β_1, in equation (2) will be statistically significant. Simulations show that the MRA estimate of β_0 in equation (2) also serves as a test for genuine empirical effect *corrected for publication bias* (Stanley 2007). Because $1/s_i$ is the precision of this estimate of the empirical effect, Stanley calls this test (H_0: $\beta_0 = 0$) the PET, which makes the meta-regression model equation (3) FAT-PET MRA (Stanley 2005).

The FAT-PET MRA model offers a unified framework from which to assess: (a) the existence of selection bias in an empirical literature; and (b) correction to any selection bias. In the remainder of the paper, we estimate versions of equation (3).

Descriptive statistics of the variables included in our MRA are presented in Table 5, for the all-set. Columns 2 and 5 present the statistics for the actual variables for the estimates of the income effect. Columns 3 and 4 present the statistics for the estimates of the population effect.

Table 5. Descriptive statistics of MRA explanatory variables

Variable Effect	(2) All-set Poverty effect	(3) All-set Population effect	Variable	(5) All-set Poverty effect	(6) All-set Population effect
t-statistic	-1.61 (5.33)	-0.32 (6.79)	Aid/GDP	0.11 (0.31)	0.09 (0.28)
s_i	0.11 (0.07)	0.10 (0.07)	Aid in $	0.44 (0.50)	0.41 (0.49)
Share of aid	0.14 (0.35)	0.16 (0.37)	Multilateral	0.32 (0.96)	0.25 (0.43)
Per capita	0.33 (0.47)	0.34 (0.47)	World Bank	0.22 (0.93)	0.14 (0.34)

Figures in brackets are standard deviations.

3.3 The meta-regression analysis of Table 6

The FAT-PET MRA results for the income on aid effect are presented in Table 6.

Column 1 reports the estimates of equation 3, using all available estimates. The constant is negative, and it is statistically significant. This indicates that selection bias in this literature exists, and that it is in the direction of favoring negative coefficients, confirming the impression of the funnel plot. The size of the selection bias is, however, small so that inferences are not greatly distorted by selection bias in this literature.[12] The coefficient on $1/s_i$ is an unbiased estimate of the effect of income on aid, corrected for selection bias. It is negative and statistically significant.

Taking all estimates into account, we find that gdp has a negative effect on aid allocation. In constructing column 1, all estimates are grouped together. However, while all 1,030 estimates relate to income and aid, aid can be measured in different ways.

Table 6. FAT-PET MRA, estimates of the income effect
(Dependent variable = t-statistic = ε_i / s_i)

Variable	(1) All-set	(2) All-set	(3) All multi-laterals	(4) World Bank	(5) Bilateral Donors	(6) (5) with dummies	(7) Middle-income bias Linear	(8) Middle-income bias non-linear
Constant	**-0.86**	**-0.68**	0.07	-0.51	-0.35	0.47	**1.45**	**-0.96**
	[5.3]***	[2.3]**	[0.1]	[0.8]	[0.9]	[1.2]	[4.9]***	[3.4]***
$1/s_i$	**-0.05**	-	-	-	-	-	-	-
	[3.8]***							
Aid/GDP	-	-0.01	**-0.35**	**-0.31**	**0.11**	0.06	-	-
		[0.2]	[4.9]***	[3.6]***	[3.8]***	[1.4]		
Share of aid	-	**-0.14**	**0.21**	**0.26**	**-0.28**	**-0.23**	**-0.18**	-0.04
		[3.2]***	[2.9]***	[3.2]***	[9.7]***	[5.6]***	[4.9]***	[1.3]
Per capita	-	-0.03	**0.21**	**0.41**	**-0.14**	**-0.09**	**-0.11**	0.02
		[0.6]	[2.4]**	[4.7]***	[4.9]***	[2.1]**	[3.3]***	[0.8]
Total aid	-	-0.03	**0.29**	**0.27**	**-0.23**	**-0.17**	**0.09**	-0.04
		[1.1]	[3.2]***	[2.9]***	[3.9]***	[3.1]***	[2.8]***	[1.5]
AR^2	0.03	0.06	0.15	0.23	0.12	0.24	0.14	0.04
k	123	123	39	28	114	114	17	17
N	1,030	1,029	246	149	861	861	124	126

Absolute t-statistics reported in square brackets are derived from applying the bootstrap to derive robust standard errors. All RHS variables have been divided through by s_i. Bold numbers are statistically significant at the 5% level. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Some observations are lost due to missing information. N is the number of estimates, while k is the number of studies. The base for column 6 is the USA.

12. Using Monte Carlo simulations, Doucouliagos and Stanley (2007) show that for absolute values of $\beta_0 < 1$, the effects of selectivity on inference are modest.

Column 2 adds three variables to capture differences in the measurement of the dependent variable: The share of aid (recall definition), per capita aid, and total absolute dollar amount of aid. The base for this regression is aid as a percentage of GDP. These results show that shares of aid allocations have a negative association with gdp: The poverty effect is confirmed.

Columns 3 and 5 report the FAT-PET separately for multilateral agencies and bilateral donors. For multilateral agencies, the partial correlation between aid-to-gdp and gdp is -0.35. This means that income is of significant importance to their aid allocation decisions. The partial correlations for the share of aid, per capita aid, and total aid allocated are -0.14, -0.14 and -0.06, respectively (e.g. for share of aid the coefficient is -0.35 +0.21 = -0.14). Regardless of the measure of aid, the empirical literature has established a negative association between income and the aid allocated by multilateral agencies. Also, here a clear poverty effect emerges.

Column 4 focuses on the estimates relating to the World Bank. The partial correlation between income and aid-to-gdp is similar to all multilateral agencies (-0.31 compared to -0.35). The partial correlations for the share of aid, per capita aid, and total aid allocated are -0.05, +0.10 and -0.04, respectively. These are noticeably smaller than for all multilateral agencies. This seems to suggest that poverty is of lesser importance to the Bank, and is consistent with the notion that the World Bank is more inclined to fund successful projects than projects relating to poorer countries.[13] The positive correlation for per capita aid is inconsistent with the other responses.

The results for bilateral donors are mixed. Share of aid, total aid, and per capita aid all have a negative coefficient. However, the positive coefficient for aid-to-gdp in column 5 is surprising. Closer inspection of the data shows that this result might be driven by aggregation bias. Equation 3 was rerun with the addition of eight country dummies: Australia, Japan, Canada, Italy, Germany, UK, Netherlands, and Scandinavia (Denmark, Sweden, Finland, and Norway grouped together), with the US as base.[14] The key results are reported in column 6. The share of aid, per capita and total aid continue to have negative signs, while aid/gdp is now insignificant from zero. However, these relate to the US. Of the eight country dummies for aid-to-gdp, four have negative coefficients: Australia (-0.38, t = -4.72), the U.K. (-0.13, t = -2.04), the Netherlands (-0.15, t = -2.13), and Scandinavia (-0.18, t=-5.58). Italy is the only

13. Note, however, that this conclusion is drawn from past studies. There are indications that in recent years the World Bank has become more focused towards poverty reduction.
14. The choice of donor dummies was purely data driven. These are the donors for which the greater majority of individual donor estimates have been reported.

country with a positive coefficient (+0.10, t = 1.84). Hence, we conclude that the accumulated evidence points quite clearly to the importance of poverty with regard to the allocation of aid for both multilateral agencies and bilateral donors. With the exception of Italy, the results suggest that when aid is measured as share of aid, per capita aid, or total aid, the humanitarian response is larger for bilateral donors than it is for multilateral agencies. In contrast, when aid is measured as a percentage of GDP, multilateral donors appear to be more responsive to humanitarian needs.

Table 6 uses the bootstrap to derive standard errors because of potential dependence in the estimates. As an alternative approach, we have tried a clustered data analysis (not reported) where the estimates reported by each study are treated as a distinct cluster. The results are similar to those reported in Table 6. This is very reassuring. Removing any observations that appear to be outliers, also doesn't change the results.[15]

The final MRA analyses reported in columns 7 and 8 relate to the middle-income effect. This has been explored in only 17 of the 124 studies, involving the inclusion of both linear and non-linear income terms that attempt to define a non-linear association: aid is meant to increase with income until a certain threshold, and then a negative association should be observed. Our own analysis of the data (section 2) suggested an absence of such a middle-income effect. What does the accumulated empirical evidence suggest?

Column 7 presents the FAT-PET regression for only those linear terms that come from a non-linear model. Note one important feature of this sub-group of the literature is that there are no estimates using aid-to-GDP as the aid measure. Accordingly, total aid is used as the base. This has the desired positive coefficient, though it is small. However, if aid is measured as per capita aid or as the share of aid, a negative coefficient emerges, invalidating the middle-income bias hypothesis.

Column 8 reports the FAT-PET for the non-linear term. None of these are statistically significant, even though two have the expected negative sign.

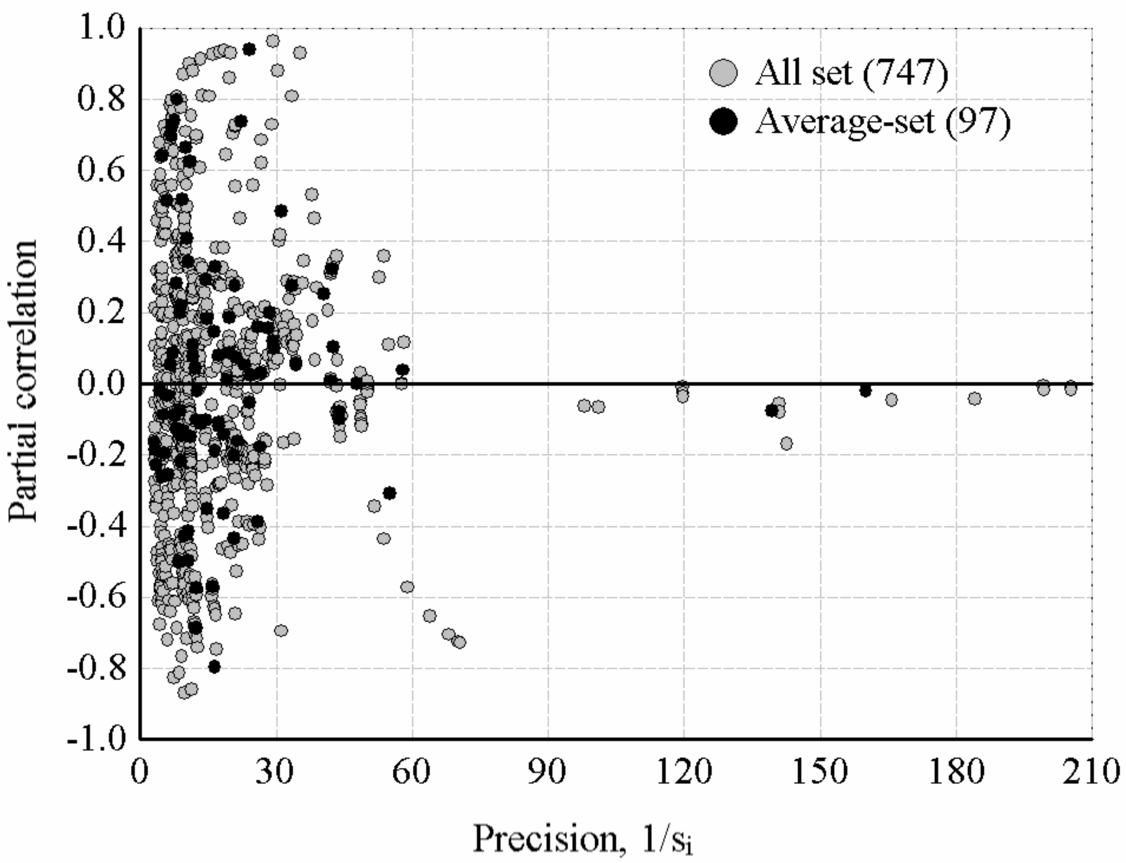
We conclude from the meta-analysis results presented in columns 7 and 8 that the middle-income bias is not supported by the literature. This is consistent with our own primary data analysis.

15. Potential outliers were detected by Hadi's (1994) method: It pointed to 20 observations as outliers.

4. Meta study 2: The population effect

We adopt the same framework for the meta-regression analysis of estimates of the population effect. Here, the funnel plot of Figure 5 covers the 747 reported estimates of the effect as well as the 97 estimates, using an average from each study. Once again, the funnel looks fairly symmetrical, and it appears that it converges to a negative result.

Figure 5. Funnel plot of estimates of the population effect



The associated FAT-PET MRA results for the all-set are presented in Table 7. Column 1 shows that selection effects exist in this literature, but again the size of the effect is modest.[16] The coefficient of $1/s_i$ indicates a small negative effect (-0.04) once the selection bias is corrected. That is, taking all estimates into account, larger countries receive less aid.

Column 2 controls for the principal differences in the measurement of aid allocations. The coefficient of $1/s_i$ in column 2 now represents aid as a percentage of GDP. The negative

16. The positive coefficient on the constant suggests that selection bias in this literature is in favor of reporting a positive population effect.

coefficient on this term indicates that larger countries (as measured by population) receive *less* aid, as was the case with our own analysis of the data presented in Section 2.

However, both the coefficient on *Share of Aid* and the coefficient on *Total Aid* are positive – the larger the country, the more aid it receives in absolute amounts, and the greater the share of all aid is distributed. These effects appear to be robust. Taken together, they suggest that donors give more aid in total to larger countries, but the share in terms of GDP is smaller for larger countries, and hence the population effect is confirmed.

Table 7. FAT-PET MRA, estimates of the population effect
(Dependent variable = t-statistic = ε_i / s_i)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All-set	All-set	Bilateral	All multi-	World	Population bias	
Variable			donors	laterals	Bank	linear	non-linear
Constant	**0.67**	**-1.74**	**-1.60**	-0.19	1.07	**-2.52**	**2.66**
	[2.8]**	[-6.3]***	[-5.7]***	[-0.2]	[1.6]	[-2.2]**	[2.5]**
$1/s_i$	**-0.04**	-	-	-	-	-	-
	[-2.7]***						
Aid/GDP		**-0.06**	**-0.07**	**-0.36**	**-0.44**	-	-
		[-2.1]**	[-2.2]**	[-3.9]***	[-4.9]***		
Share of aid	-	**0.22**	**0.24**	**0.43**	**0.75**	-0.14	0.05
		[6.1]***	[6.4]***	[5.0]***	[7.9]***	[-1.9]*	[0.70]
Per capita	-	0.01	0.02	0.02	-0.10	**-0.29**	**0.15**
		[0.1]	[0.5]	[0.21]	[1.1]	[-6.4]***	[5.5]***
Total aid	-	**0.35**	**0.35**	**0.48**	**0.50**	**0.30**	**-0.16**
		[9.0]***	[8.7]***	[6.4]***	[5.8]***	[6.1]***	[4.8]***
Adjusted R^2	0.02	0.24	0.27	0.34	0.66	0.20	0.06
k	97	97	91	32	22	12	12
N	747	747	617	182	102	89	89

Absolute t-statistics reported in square brackets are derived from applying the bootstrap to derive standard errors. All RHS variables have been divided through by s_i. Bold numbers are statistically significant at the 5% level. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. N is the number of estimates, while *k* is the number of studies.

Columns 3 and 4 report the results for the bilateral donors and multilateral agencies, respectively. In all cases, the FAT-PET MRA results suggest that bilateral donors have smaller negative or larger positive coefficients. For example, in terms of aid/GDP and in terms of per capita income, the coefficient for bilateral donors is -0.07, compared to -0.36 for all multilateral agencies, and -0.44 for the World Bank. This means that all donors give less aid as a percentage of GDP, but the World Bank gives much less than bilateral donors: the population bias is larger for World Bank allocations. In terms of total aid, the coefficient for bilateral donors is +0.28, compared to +0.12 and +0.06, for all multilateral donors and the World Bank, respectively. That is, the larger a poor country is, the more aid in total it receives, but it receives relatively more from bilateral donors.

Columns 1 to 5 focus on the linear terms that have been the major focus in this literature. Our final meta-analysis is a direct test of the non-linearities in the population bias. This involves FAT-PET regressions on the non-linear terms. Column 6 reports the FAT-PET for those linear terms that have been estimated in the context of a non-linear model. The results are essentially the same as when all the linear terms are analyzed. The one difference of note is that again none of these estimates relate to aid as a percentage of GDP. Hence, the base for this regression is total aid. This subgroup of the linear population effects literature shows that more aid is allocated in total to larger poorer countries, with a small positive effect on a per capita basis (per capita allocations = 0.30 – 0.29 = 0.01).

Table 8. The population effect: Controlling for fixed effects and non-linearities, 1967 – 2004

	(1)	(2)	(3)	(4)	(5)	(6)
Exogenous variable	Aid share, *h* = aid/GNP			Total aid in real $		
	Pooled	Country	Country and	Pooled	Country	Country and
Endogenous variable	OLS	FE	time FE	OLS	FE	time FE
Lagged aid	**0.57**	**0.27**	**0.26**	**0.64**	**0.40**	**0.39**
	(3.9)***	(3.8)***	(3.9)***	(11.4)***	(7.5)***	(7.1)***
Per capita real GNP_{t-1}	**-1.64**	**-0.28**	-1.06	**-476.4**	**-316.9**	-280.7
	(-3.4)***	(-3.5)***	(1.9)*	(3.5)***	(3.6)	(1.7)*
Population $_{t-1}$	**0.013**	**-0.022**	**-0.032**	**3.029**	-2.834	-4.379
	(2.9)***	(2.1)**	(2.8)***	(5.9)***	(1.0)	(1.7)*
Population $_{t-1}$, squared	**-0.001**	0.0002	0.0006	**-0.221**	0.059	0.143
	(-3.0)***	(0.3)	(1.1)	(5.4)***	(0.4)	(1.0)
Adjusted R^2	0.57	0.64	0.64	0.61	0.66	0.67
j	147	147	147	147	147	147
n	4,188	4,188	4,188	4,188	4,188	4,188

Notes: Population is measured in millions. Absolute t-statistics reported in brackets using robust standard errors. Bold numbers are statistically significant at the 5% level. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. n is the number of observations, while *j* is the number of countries. FE means fixed effects.

Column 7 reports the FAT-PET for the associated non-linear terms. The negative coefficient on total aid indicates that total aid rises initially for larger poorer countries but does so in a non-linear manner. The non-linear effect for per capita is small, but it is larger for total aid.

The finding of a non-linear association is different to what we found in our own analysis presented in Section 2, which uses a longer time period and a wider group of countries.

Table 8 shows that one explanation for this may be the estimation procedure. Table 8 reports our own panel data analysis for 147 countries for the period 1967 to 2004. The dependent variable in the first three columns is aid/GDP, while total aid is used in columns 4 to 6. Aid allocations are regressed on lagged aid, the income effect, and the linear and non-linear population effects. Columns 1 and 4 report the results of using pooled least squares. Columns 2 and 5 use country fixed effects, while columns 3 and 6 use country and fixed effects. Note that in contrast to the results of Tables 2 and 3 presented earlier, we have not logged the explanatory variables here. It is quite clear from the results that the non-linearity of the results disappears once country fixed effects are controlled for.

It is important to note, however, that in all cases, the results support the population bias hypothesis. The population hypothesis is supported if either of the linear and non-linear coefficients are negative.

5. Explaining the results

The preceding sections have established two facts:

The income effect: The poorer the recipient country is, the more aid it gets per capita. This effect explains about 10% of the variation in the aid share.

The population effect: The larger the population of the recipient country, the more aid it gets in total, but the less aid it receives as a percentage of its GDP. This effect explains about 6% of the variation in the aid share.

Many other explanatory factors have been used in the aid allocation literature. Also, different donors have different motives, so it is important that the two facts are robust.

5.1 Should the results differ for bilateral and multilateral donors?

Several empirical studies have focused exclusively on the issue of bias in the aid allocation process of multilateral agencies. Examples include Cline and Sargen (1975), Arvin, Rice and Cater (2001), and Neumayer (2003c), while many others explore the behavior of both bilateral and multilateral donors.

Cline and Sargen (1975) argue that multilateral agencies tend to be protected from ‘temporary political oscillations’ so that they can be expected to be more focused on economic criteria for aid allocation. Other aspects of multilateral agency allocations include the administrative and organizational efficiency of the agencies and their effectiveness in allocating funds on the basis of need (see, for example, the references in Arvin, Rice and Cater 2001, and the study by Barrett and Heisey 2002). There are also important agency and governance issues involved. For example, Congleton (2006, p. 335) argues that given their nature: “International agencies are predicted to be underfinanced, undermonitored, and under-sanctioned.” Moreover, there is the important issue of bilateral donors influencing the allocation decisions of multilateral agencies (Neumayer 2003c, and Kilby 2006).

Thus, it is unlikely that the same mix of policy pressures operate on bilateral and on multilateral donors.

5.2 Explaining the income effect, and a look back to Figure 1

It is not difficult to understand that the poverty of the recipient country is a highly significant and increasing factor explaining aid allocation. This is in accordance with the expressed goal of all donors and the rationale of development aid from the start. In fact, it seems that the goal of poverty reduction is everywhere proclaimed as the overriding goal of aid.

The only puzzle is that this variable barely explains 10% of the variation, as was obvious already from looking at the observations on Figure 2. We think that a goal that has the status mentioned has very little explanatory power.

One possible explanation of the low power may be that the poverty effect is only one of the relations in the AAL-AEL-nexus drawn on Figure 1. The relations between aid, income and growth have been analyzed in separate bodies of literature. Table 9 (that repeats Figure 1 in a different representation) summarizes the findings about the relations in the literature.

Table 9. The causal links discussed in the present and related bodies of literature

	Causal link	Literature	Sign	Size	Significance	Reverse causality bias
			The relations between levels of income and aid			
(1)	Income ➔ Aid	AAL, present paper	−	Small	High	No bias
(2)	Aid ➔ Income	-	(+?)	Dubious via (4)	None	Positive bias
			The relations between the growth rate and aid			
(3)	Growth ➔ Aid	AAL [a)]	+	Small	Mostly significant	No bias
(4)	Aid ➔ Growth	AEL [b)]	(+?)	Dubious	Insignificant	Dubious positive bias
			The well-known relations between the growth rate and the income level			
(5)	Income ➔ Growth	Convergence Lit	(+?)	Dubious	Insignificant	Sorted out
(6)	Growth ➔ Income	Growth Lit	+	Strong	Long run	Sorted out

Note: AAL is aid allocation literature, AEL is aid effectiveness literature. (a) covered in Doucouliagos and Paldam (2007a), and (b) covered in Doucouliagos and Paldam (2007b).

Most of the causal links produce small and even dubious effects, so the likelihood of biases is very limited. Though many have tried simultaneous estimation techniques on the relations (1), (3) and (4), this rarely has a substantial effect. Thus, we can trust that poverty has the effect found on aid flows.

5.3 Explaining the population effect

The scatter diagram for the aid share over country size is shown in Figure 3. It looks like Figure 2 though the pattern in the scatter is marginally weaker. However, the estimate of the coefficient to the slope is also very significant and robust. This is much more difficult to explain as it appears not to be in accordance with the stated policy of any donor. Thus, we have to understand it as a result of the politico-administrative processes operating in the process of aid giving.

The OECD (1969), followed by Isenman (1976), were the first to discuss the population size bias in aid allocation. Isenman proposed a number of explanations, and since then other explanations have been proposed. We have classified the explanations into six families:

(1) ***Political Influence buying:*** Development aid may be seen as an attempt by the donor country – or specific bureaucracies in that country – to buy influence. The cost of influence is cheaper, the smaller the recipient country. (i) One part of the effect is a *bang for the buck effect:* It is important for donors to have a visible effect which can be communicated to taxpayers. (ii) Another part is a *pond effect:* Representatives from the donor country will inevitably be relatively bigger fish the smaller the pond, and it is nicer to be a big fish. Also, a decision-maker in a recipient country has an equal amount of time available in a small and a large country. So he can allocate less to each donor in the large country. (iii) Showing *respect* is also important in international relations. Donors might want to avoid giving small nations a proportionate amount in aid because the resulting small amount might appear to be insulting to the recipient nation. Note that these three factors may affect multilateral aid allocation as much as they affect bilateral aid allocation.

(2) ***Results of the power distribution in international organizations***. It appears that small countries have disproportionably more power in international organizations. This applies especially to the UN. Also, small nations tend to have less interest in power-politics, and consequently their interests are more concentrated on the economy. Thus, small countries may get a disproportionable share of aid for two reasons: (a) they have relatively more power, and (b) they may sell their support to large nations in their power-play in exchange for aid.[17]

Many argue that with the end of the Cold War, political considerations in the allocation of aid have diminished. The empirical analysis in Table 3 is at best a weak support for this view. Also, the points noted under (1) and (2) extend beyond the context of the Cold War.

(3) ***Commercial influence buying:*** Trade is relatively more important for smaller nations, and it can be advantageous to use aid as a means of establishing important trade and other commercial links. Tied aid is only part of this process. This motive should not apply to international organizations.

(4) ***LDC Status seeking:*** Countries often aim for a larger international status. This is more realistic the larger the country. (i) To receive aid is a sign of weakness, so international

17. This is further analysed in the literature on the relation between aid and the way countries vote in the UN general assembly, as pioneered by Wittkopf (1973) and Rai (1980). See also Dreher and Sturm (2006). Another body of literature analyses how small countries may get a relatively good deal in international organizations as they are able to free ride. It took off from Olson and Zeckenhauser (1966).

status seeking reduces the demand for aid more so for larger countries. Also, it is likely to reduce the supply of aid for two additional reasons: (ii) Status seeking by new countries will create rivalry with countries having such a status already, which may be wealthy donors. Thus, tensions/conflicts will occur between the donor community and the large LDCs. (iii) Large LDCs may undertake their own aid programs as tools to seek status. It then becomes awkward for a donor to give aid to a country that gives aid itself. Reversely, smaller countries may pursue aid seeking strategies as they can not obtain a high status anyhow. Also, they may want to get donors into their country as a counterweight to local powers.

(5) ***Country size and black spots:*** It is well known that most (if not all) countries have black spots that cause unfavorable comments in the international press.[18] It may be an ethnic conflict, or a lack of one or another civil liberty, it may be corruption, etc. *Ceteris paribus*, the number of black spots is likely to increase with country size. This can make aid allocation problematic and potentially embarrassing for donors in the eyes of their own citizens, and in the eyes of the international community. The same applies to white spots, but they are less newsworthy. Thus, if the supply of aid depends negatively on the amount of negative press, the small countries have an advantage.

(6) ***Aid effectiveness:*** Aid is more visible in small countries and might, hence, be easier to monitor. Further, Dowling and Hiemenz (1985) argue that larger countries are more vulnerable to bottlenecks and inefficiencies, and this might make them less attractive to donors. There seems to be no support in the AEL for the notion that aid is less effective in larger countries than in smaller, so for now this point will be disregarded.

The first five points are part of a broader argument supported by other evidence, so it appears that they all have some empirical value. However, several are overlapping, and their importance is likely to have changed over time. Consequently, we are not, at present, able to give weights to the importance of the five factors.

18. A dozen papers in the AAL consider the importance of the news coverage in the donor countries of events in the recipient countries for aid to the same countries. See e.g. Belle and Hook (2000) and Belle (2003).

6. Concluding remarks: The poverty and the population effects

The paper has assessed the importance of the size of the recipient country for the development aid they receive. The analysis looks at two variables measuring size: Income and population. Both have a significant negative impact, but neither has a big explanatory power. For both variables, we have looked at all the available data and at all empirical studies. That is, we have looked at about 800 data points and the cumulative knowledge reached by 40 years of research. It is reassuring that both our own study and the meta studies tell the same story:

Income: Donors often proclaim poverty alleviation as the main reasons for allocating aid. Accordingly, most commentators and researchers expect an inverse association between aid allocation and income. Here, the meta study considers 124 empirical studies which offer 1,030 estimates of the aid-GDP effect.

The results show that for most donors – whether they are bilateral of multilateral – there is indeed an inverse association between aid and GDP. Importantly, this association occurs throughout the observed data range: the accumulated evidence does not support the notion of a middle-income bias. The inverse aid-income relation explains only about 10% of the variation in the data. Thus, even when the income-aid relation is both significant and robust it is not a very powerful relation – many other factors count for the allocation of aid.

Population: Donors rarely, if ever, state that their goal is to support small rather than large countries, and as the donors covered by the statistics are democratic countries and multilateral institutions, such a goal should be openly stated. Thus, any effect found on the aid share is a *population-bias* generated by the behavior of the agents of the aid giving process. Here, the meta study covers 97 studies that offer 747 estimates. And they tell a clear story:

Countries with larger populations receive larger amounts of aid, but not in proportion to their GDP: Aid as a percentage of GDP falls, the more populous a nation is. The evidence strongly suggests that the population bias is stronger for multilateral organizations, and that it is stronger still for World Bank allocations. This finding is particularly informative.

A priori, it is unclear if the humanitarian and development orientation of bilateral versus multilateral agencies is the largest. On the one hand, it can be argued that bilateral donors are more likely to pursue their own national and foreign policy interests and, hence, potentially downplay humanitarian concerns. On the other hand, multilateral agencies may be ineffective and under-resourced to meet humanitarian obligations. The donors might also be influenced in their allocations by the interests of large contributors. The available evidence reviewed in this paper strongly suggests that multilateral agencies are, on average, actually less predisposed towards allocating aid on the basis of humanitarian concerns: the income effect is weaker while the population effect is stronger.

Several issues remain to be explored. For example, it is not surprising that the aid share falls with income in the recipient country, but it is surprising that this effect is of a rather modest explanatory power. As a rule of thumb, it only explains 10% of the large variation in the aid share. It would be very informative to uncover the reasons for this. It would be useful also for future research to shed further light on the observed population effect by investigating empirically the various reasons that may drive this result. Furthermore, the finding that the aid allocation of bilateral donors tends to be more biased towards humanitarian concerns warrants further analysis. It could, for example, be one reason why donor countries contribute to multilateral agencies and at the same tine maintain their own bilateral aid programs.

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Appendix A: The studies covered

Studies reporting income and population effects are provided with a *y* and an *n*, respectively.

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